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MINI REVIEW

Hyponatraemia in heart failure: a mechanistic approach to contemporary management

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Abstract

Hyponatraemia remains the most prevalent electrolyte disturbance in heart failure, complicating clinical management and correlating with adverse outcomes. While traditionally viewed as a biomarker of disease severity, mounting evidence suggests that hyponatraemia reflects specific pathophysiological mechanisms that demand targeted intervention alongside standard decongestion strategies. This mini review synthesises contemporary evidence to provide clinicians with an updated, mechanistically grounded approach to hyponatraemia in heart failure. We emphasise the critical distinction between dilutional hypervolaemic states driven by arginine vasopressin dysregulation and depletional hypovolaemic states arising from aggressive diuresis or sodium losses. Recent trials challenge longstanding practices: fluid restriction in stable chronic heart failure shows no quality-of-life benefit despite guideline recommendations, whilst emerging biomarkers such as early urine chloride offer promise in identifying diuretic resistance. We critically appraise the role of vasopressin antagonists, which correct sodium biochemically but lack mortality benefit, and explore oral urea as a pragmatic alternative supported by recent observational data. For acute severe presentations, we detail hypertonic saline protocols with strict correction limits and discuss proactive desmopressin strategies to prevent osmotic demyelination. Important knowledge gaps persist, including optimal diagnostic algorithms in diuretic-exposed patients, patient-centred outcome data for sodium-correcting therapies, and validation of safe-correction protocols. Overall, this review equips clinicians to integrate mechanistic understanding with evidence-based practice whilst identifying priorities for future investigation.

Keywords Hyponatraemia · Heart failure · Decongestion · Hypertonic saline · Tolvaptan · Urea

Introduction

Hyponatraemia, defined as serum sodium < 135 mmol/L, is the most common electrolyte disturbance in heart failure (HF) [1, 2]. It complicates approximately 20% of acute and advanced chronic HF admissions and is associated with prolonged hospitalisation and increased mortality, with particularly poor outcomes in the 1–2 years following HF diagnosis [1–4]. Improvement of sodium levels during HF treatment correlates with better survival, although causality remains debated [5]. Nonetheless, persistent hyponatraemia often reflects inadequate decongestion, as patients discharged with residual fluid overload tend to experience worse outcomes [1, 2]. This underscores that electrolyte derangements and congestion are interrelated therapeutic targets in HF management [1–5].

From a health systems perspective, managing hyponatraemia in HF poses substantial practical challenges [6–9]. Crowded telemetry units and intensive care beds necessitate that clinicians triage care efficiently. Severe hyponatraemia (< 120 mmol/L) can precipitate neurological emergencies, such as altered mental status, seizures, and even coma, demanding immediate therapy even amid busy workflows [6, 7, 10]. Conversely, chronic mild hyponatraemia can delay discharge if not addressed, creating bottlenecks as patients await sodium correction to safer levels [6, 7, 11]. Traditional approaches, such as prolonged fluid restriction

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recommended by European Society of Cardiology (ESC) guidelines [12], often yield only marginal sodium improvements [6, 12–14], challenging patient adherence and straining nursing resources [12].

These realities underscore the need for an updated evidence-based approach to support clinical decision-making. Such an approach should identify the mechanism of hyponatraemia, treat it effectively in parallel with HF decongestion based on current evidence, and avoid known complications such as osmotic demyelination syndrome (ODS) or volume mismanagement. This mini review therefore synthesises recent evidence and proposes a phenotype-informed management framework that integrates dilutional and depletional hyponatraemia physiology, to support safe and effective clinical care.

Pathophysiology

Hyponatraemia in HF predominantly reflects sustained neurohormonal activation drives water retention out of proportion to solute excretion [1, 3, 4, 15]. Reduced cardiac output, lowered renal perfusion, and venous congestion trigger compensatory activation of the renin-angiotensin-aldosterone system (RAAS) and sympathetic nervous system, increasing tubular sodium avidity and thirst, and predisposing to free-water retention and compounding fluid overload [3, 6]. Within this context, while osmotic regulation of arginine vasopressin (AVP, antidiuretic hormone) remains largely intact, AVP levels may remain inappropriately elevated relative to plasma osmolality, indicating a dominant non-osmotic drive [16, 17]. Elevated AVP levels act on V2 receptors in the renal collecting ducts to insert aquaporin channels, enhancing free water reabsorption and diluting serum sodium [3]. Simultaneously, AVP-mediated V1a receptor activation causes systemic vasoconstriction, increasing afterload and myocardial oxygen demand in an already compromised heart, further perpetuating the haemodynamic and neurohormonal milieu that sustains AVP signalling. This results to dilutional hyponatraemia with hypervolaemia and inappropriately elevated urine osmolality [3, 4, 6, 15, 18, 19].

Clinically, dilutional physiology predominates at presentation in most series, whereas depletional hyponatraemia is less common and often iatrogenic [3, 6, 19, 20]. In phenotyping cohorts, dilutional hyponatraemia typically accounts for approximately 40% to 56% of hyponatraemic HF cases, with the remainder classified as depletional [21, 22].

By contrast, depletional hyponatraemia most often follows aggressive diuretic therapy, particularly with loop and thiazide diuretics, when renal solute loss exceeds water loss [3, 4, 6]. Additional causes include gastrointestinal losses (vomiting, diarrhoea) and, rarely, extreme dietary sodium restriction [3, 6]. Importantly, depletional hyponatraemia may present with persistent oedema, mimicking euvolaemia or hypervolaemia on clinical examination and obscure the underlying mechanism [3, 4, 6, 18, 23]. Distinguishing dilutional from depletional mechanisms is therefore essential, as management strategies differ fundamentally [6].

Diagnosing Non-severe hyponatraemia in heart failure

We outline a stepwise diagnostic approach integrating contemporary guidance with evidence-based treatment recommendations for hyponatraemia in HF (Fig. 1; more details in Supplementary Figure S1). Non-severe hyponatraemia is defined by the absence of severe or moderately severe neurological symptoms, including seizures, coma, marked confusion, or vomiting [6]. First, confirm hypotonic hyponatraemia with a measured serum osmolality < 275 mOsm/kg, excluding translocational or pseudohyponatraemia by accounting for hyperglycaemia, paraproteinaemia, and hyperlipidaemia [3, 6, 10, 12, 24, 25]. Obtain concurrent spot urine samples during blood collection [6]. Urine osmolality < 100 mOsm/kg indicates maximally dilute urine, usually reflecting excess water intake (psychogenic polydipsia) or minimal solute intake; conditions uncommon in HF that require alternative approaches and further endocrinological assessment [12, 24, 26].

When urine osmolality is > 100 mOsm/kg, measure urine sodium. Urine sodium < 30 mmol/L indicates either depletional hyponatraemia from over-diuresis and dilutional HF with hypervolaemia [10, 24]. Values > 30 mmol/L suggest syndrome of inappropriate antidiuretic hormone secretion (SIADH) or renal salt wasting [10, 24]. However, in diuretic-treated HF patients, urine sodium interpretation is confounded as loop and thiazide agents increase natriuresis independent of volume status [10, 24].

Fractional excretion of uric acid (FEUA) provides diagnostic clarity in this context. A 2020 Italian retrospective study demonstrated that FEUA discriminated SIADH from diuretic-induced hyponatraemia more effectively than serum uric acid in loop diuretic-treated patients (area under the curve [AUROC] 0.96 versus 0.88; both $P < 0.001$) [10, 27]. FEUA > 10–12% supports SIADH (100% specificity, 85% sensitivity), whereas values ≤ 8 argues against SIADH (100% sensitivity, 72% specificity), suggesting sodium depletion [10, 27]. Notably, FEUA does not reliably distinguish SIADH from thiazide-induced hyponatraemia; thiazide withdrawal before interpretation is advisable when feasible [10, 27]. When the biochemical patterns suggest SIADH in a patient with HF, exclude hypothyroidism

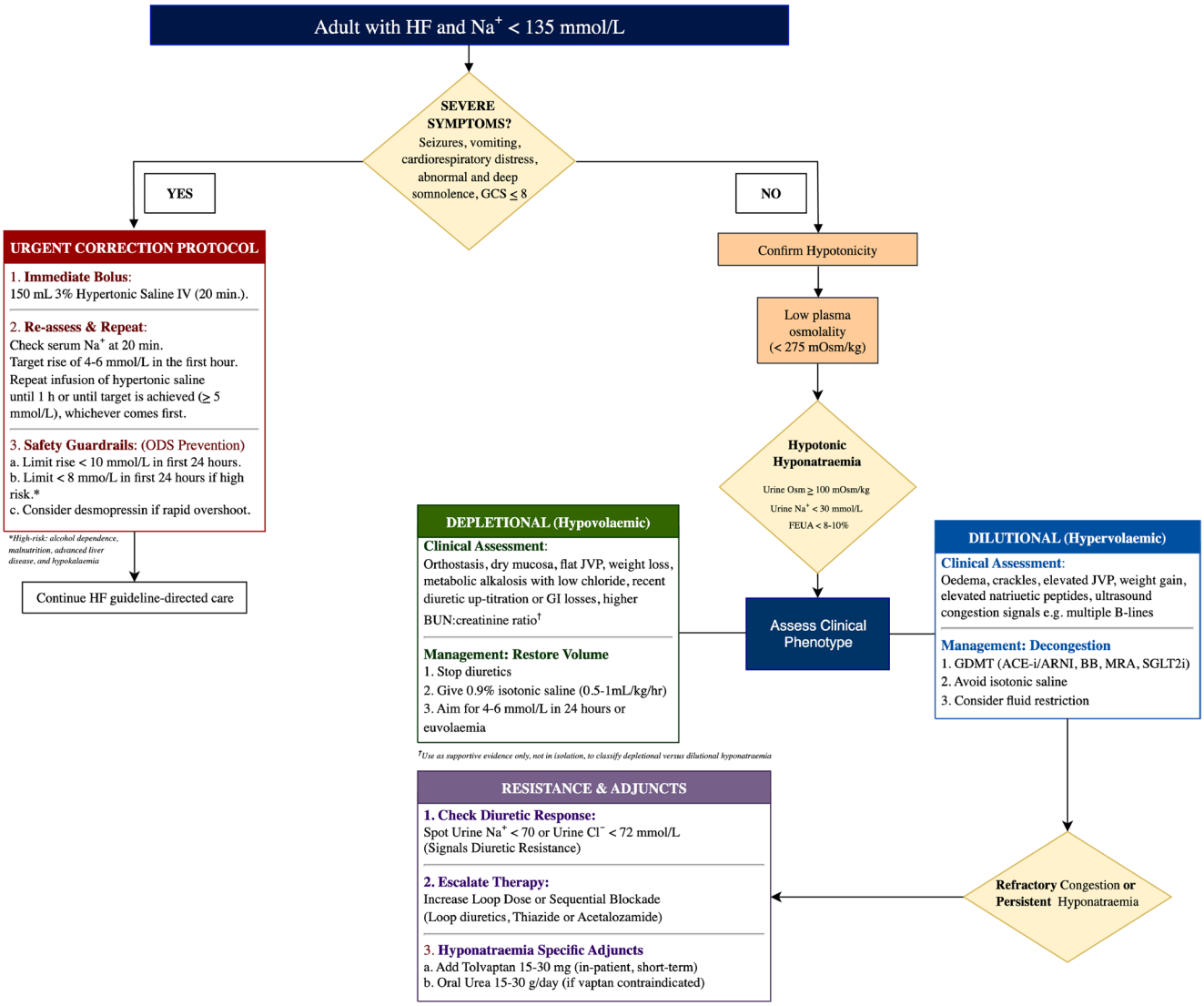
Adult with HF and Na+ < 135 mmol/L
SEVERE SYMPTOMS?
Seizures, vomiting, cardiorespiratory distress, abnormal and deep somnolence, GCS ≤ 8
YES
NO
URGENT CORRECTION PROTOCOL
1. Immediate Bolus:
150 mL 3% Hypertonic Saline IV (20 min.).
2. Re-assess & Repeat:
Check serum Na+ at 20 min.
Target rise of 4-6 mmol/L in the first hour.
Repeat infusion of hypertonic saline until 1 h or until target is achieved (≥ 5 mmol/L), whichever comes first.
3. Safety Guardrails: (ODS Prevention)
a. Limit rise < 10 mmol/L in first 24 hours.
b. Limit < 8 mmo/L in first 24 hours if high risk.*
c. Consider desmopressin if rapid overshoot.
*High-risk: alcohol dependence, malnutrition, advanced liver disease, and hypokalaemia
Continue HF guideline-directed care
Confirm Hypotonicity
Low plasma osmolality (< 275 mOsm/kg)
Hypotonic Hyponatraemia
Urine Osm ≥ 100 mOsm/kg
Urine Na+ < 30 mmol/L
FEUA < 8-10%
Assess Clinical Phenotype
DEPLETIONAL (Hypovolaemic)
Clinical Assessment:
Orthostasis, dry mucosa, flat JVP, weight loss, metabolic alkalosis with low chloride, recent diuretic up-titration or GI losses, higher BUN:creatinine ratio†
Management: Restore Volume
1. Stop diuretics
2. Give 0.9% isotonic saline (0.5-1mL/kg/hr)
3. Aim for 4-6 mmol/L in 24 hours or euvolaemia
†Use as supportive evidence only, not in isolation, to classify depletional versus dilutional hyponatraemia
DILUTIONAL (Hypervolaemic)
Clinical Assessment:
Oedema, crackles, elevated JVP, weight gain, elevated natriuetic peptides, ultrasound congestion signals e.g. multiple B-lines
Management: Decongestion
1. GDMT (ACE-i/ARNI, BB, MRA, SGLT2i)
2. Avoid isotonic saline
3. Consider fluid restriction
Refractory Congestion or Persistent Hyponatraemia
RESISTANCE & ADJUNCTS
1. Check Diuretic Response:
Spot Urine Na+ < 70 or Urine Cl− < 72 mmol/L
(Signals Diuretic Resistance)
2. Escalate Therapy:
Increase Loop Dose or Sequential Blockade
(Loop diuretics, Thiazide or Acetalozamide)
3. Hyponatraemia Specific Adjuncts
a. Add Tolvaptan 15-30 mg (in-patient, short-term)
b. Oral Urea 15-30 g/day (if vaptan contraindicated)

Fig. 1 Proposed diagnostic and therapeutic algorithm for hyponatraemia in adults with heart failure. The algorithm applies to patients with heart failure and serum sodium < 135 mmol/L. Management is stratified by symptom severity. Patients with severe or moderately severe symptoms receive prompt 3% hypertonic saline with close monitoring and predefined correction limits to minimise the risk of osmotic demyelination. In patients without severe symptoms, hypotonicity is confirmed using plasma osmolality, followed by urine studies and clinical assessment to phenotype hyponatraemia as depletional (hypovolaemic) or dilutional (hypervolaemic), guiding volume restoration versus decongestion and optimisation of guideline-directed medical therapy. For refractory congestion or persistent hyponatraemia, the algorithm highlights natriuretic response assessment, escalation of diuretic strategy, and selective use of adjunctive therapies. A detailed stepwise bedside protocol is provided in *Supplementary Figure* S1.**Note (†)**: BUN: creatinine ratio may be elevated with renal hypoperfusion, venous congestion, chronic kidney disease, or recent diuretic exposure; we suggest using it as supportive evidence only and not in isolation to classify depletional versus dilutional hyponatraemia. **Abbreviations**: HF, heart failure; Na, sodium; NaCl, sodium chloride; GDMT, guideline-directed medical therapy; JVP, jugular venous pressure; BUN, blood urea nitrogen; FEUA, fractional excretion of uric acid; DDAVP, desmopressin; V2, vasopressin type-2 receptor; uNa, urinary sodium; uCl, urinary chloride; GCS, Glasgow Coma Scale

(thyroid-stimulating hormone) and secondary adrenal insufficiency (morning cortisol) before finalising the diagnosis [24]. Collect all samples before initiating corrective therapy, then classify the aetiology using paired serum and urine results.

To discriminate between depletional and dilutional hyponatraemia, we suggest to consider several clinical features and assessments rather than relying on a single parameter [6, 10]. Depletional (hypovolaemic) HF is characterised by orthostatic hypotension, dry mucous membranes, low or flat jugular venous pressure (JVP), recent diuretic escalation or gastrointestinal losses, weight loss, metabolic alkalosis with hypochloraemia, and elevated blood urea nitrogen (BUN)-to-creatinine ratio [6]; however, in HF this ratio may also reflect reduced renal perfusion and venous congestion, and it can vary with diuretic exposure, so we suggest that this will be treated

as supportive evidence rather than a stand-alone discriminator [28–30]. Serum sodium typically rises with cautious isotonic saline administration [6, 31]. Conversely, dilutional (hypervolaemic) HF presents with peripheral oedema, pulmonary crackles, elevated JVP, weight gain, raised natriuretic peptides, and ultrasound congestion markers such as multiple lung B-lines or plethoric inferior vena cava. In these patients, serum sodium often falls or remains static with isotonic saline but improves with effective decongestion [12, 31].

Treatment of Non-Severe hyponatraemia in heart failure

Once classified as depletional or dilutional HF, treatment proceeds according to subtype (Fig. 1; Supplementary Figure S1) [6, 10]. Goals include gradual sodium improvement, alleviation of chronic symptoms attributable to hyponatraemia, and volume optimisation to interrupt AVP hypersecretion [6, 10, 12]. Table 1 summarises treatment options, monitoring priorities, and supporting evidence (study-level details in Supplementary Table S1).

Depletional (Hypovolaemic) heart failure

Discontinue the offending diuretic and cautiously administer 0.9% isotonic saline at 0.5–1.0 mL/kg/hour until euvolaemia is restored and serum sodium rises within safety limits (target ~ 4–6 mmol/L per 24 h; maximum 10 mmol/L per 24 h, or 8 mmol/L in high-risk patients) [10, 36]. This approach aligns with recommended management of hypovolaemic hyponatraemia and ESC guidelines prioritising congestion assessment alongside electrolyte correction [12, 26, 37].

Table 1 Practical therapeutics for non-severe or chronic hyponatraemia in heart failure

Therapy	Mechanism	Use case	Typical dose/ Target	Key monitoring & Safety	Evidence signal
0.9% isotonic saline	Restores intravascular volume and Na^+ depletion	Depletional HF	0.5–1.0 mL/kg/hour until euvolaemia; stop the offending diuretic	Rise of about 4–6 mmol/L over 24 h within limits	Guideline-based standard of care [12, 24]
Loop diuretics and GDMT	Enhance water and Na + excretion; reduce renal concentrating ability by blocking Na-K-Cl in Henle's loop	Dilutional HF	Individualise dose; Aim for decongestion; Up-titrate if with DR	Daily weight, urine output, renal function, electrolytes	Core HF guidance, improves congestion; Na^+ rise is secondary [12]
Fluid restriction	Limits free water intake	Persistent dilutional hyponatraemia despite decongestion	Pragmatic targets, often 1.0–1.5 L/day	Thirst, nutrition, adherence	Recommended current guidelines [12] but shows modest biochemical effect; uncertain outcome benefit; FRESH-UP 2025 showed no QoL gain and more thirst [32].
Tolvaptan (V2 antagonist)	Block V2 receptors in kidney, leading to aquaresis (water excretion without Na^+ loss)	Inpatient, persistent dilutional hyponatraemia when quicker biochemical correction is needed	15 mg orally daily to start; adjust per Na trajectory	Check Na at about 8 and 24 h, volume status, LFTs per label	Corrects Na and congestion metrics; no mortality or rehospitalisation benefit in EVEREST trial; confirmed in contemporary meta-analyses [26, 33, 34]
Oral Urea	Increases osmotic excretion (urea freely filtered, carries water out)	Dilutional hyponatraemia when vaptans unsuitable or fluid restriction impractical	15–30 g/day in divided doses	Na checks during initiation and with diuretic changes; counsel on taste	Small, recent retrospective HF cohort in 2024 showed correction without major adverse effects [26, 35]

Abbreviations: *HF* heart failure, *GDMT* guideline-directed medical therapy, *DR* diuretic resistance, *Na* sodium, *K* potassium, *Cl* chloride, *Na-K-Cl* sodium–potassium–chloride cotransporter in Henle's loop, *V2* vasopressin type-2 receptor, *LFTs* liver function tests, *QoL* quality of life, *EVEREST* Efficacy of Vasopressin Antagonism in Heart Failure: Outcome Study With Tolvaptan

Dilutional (Hypervolaemic) heart failure

Prioritise decongestion with loop diuretics and guideline-directed therapy provided that renal function is not compromised by an aetiology outside of HF [12, 24]. ESC guidelines recommend foundational therapy, including loop diuretics, sacubitril-valsartan (or ACE inhibitor/ARB), beta-blocker, mineralocorticoid receptor antagonist, and SGLT2 inhibitor, alongside intravenous loop diuretics with early uptitration and sequential nephron blockade if needed [12, 38, 39]. Consider vasodilators in hypertensive congestion, monitor renal function and electrolytes closely, and reserve ultrafiltration for refractory fluid overload [12].

Mineralocorticoid receptor antagonists (MRAs) in dilutional hyponatraemia remain a nuanced decision [12, 20]. Mechanistically, free-water excretion depends on continued sodium reabsorption in distal nephron segments with low water permeability; diuretics that impair this distal sodium reabsorption, including thiazide-type diuretics and MRAs, may therefore worsen dilutional hyponatraemia and are best avoided during active correction in selected cases [20]. However, MRAs confer established morbidity and mortality benefit in HFrEF, so clinicians should not discontinue them reflexively for mild, stable hyponatraemia [12]. A pragmatic approach is to continue low-dose MRA when sodium is stable or improving with decongestion, but to temporarily withhold or down-titrate MRA when dilutional hyponatraemia is severe or deteriorating despite an appropriate decongestion strategy, or when the phenotype is mixed and iatrogenic solute loss appears contributory. Accordingly, we suggest a summarised, approach to MRA continuation, temporary interruption, and reintroduction in hyponatraemic HF (Supplementary Table S2).

Serum sodium may improve during effective decongestion and optimisation of guideline-directed medical therapy (GDMT), particularly in dilutional hyponatraemia, although individual responses vary. If hyponatraemia persists, this may suggest diuretic resistance which may merit reassessment of volume status and review of recent diuretic exposure and fluid intake [38, 39]. Where appropriate, we also suggest escalation to intravenous loop diuretics and consider sequential nephron blockade [12, 24]. Moreover, avoiding infusion of isotonic saline in suspected dilutional states would help in clinical improvement unless overall assessment supports true depletion [12, 24]. In carefully selected patients with refractory dilutional hyponatraemia, selective V2 antagonism may offer an aquaretic option to raise serum sodium [6, 8, 26, 31, 36] alongside continue optimisation of decongestion and GDMT, guided by objective natriuretic response [12].

Natriuresis-guided titration may enhance sodium excretion. The Pragmatic Urinary Sodium-based treatment algorithm in Acute Heart Failure (PUSH-AHF; NCT04606927) trial in 2023, comparing natriuresis-guided therapy versus standard care demonstrated increased 24-hour urinary sodium (409 ± 178 versus 345 ± 202 mmol; P = 0.006), however the 180-day composite of all-cause mortality or first HF rehospitalisation did not differ (HR 0.92, 95% CI 0.62–1.38) [40]. A more recent international, multicentre pragmatic study, ENACT-HF (2024), further supports protocolised natriuresis-guided decongestion using early spot urine sodium and urine output to trigger timely loop-diuretic escalation and sequential nephron blockade over the first 48 h, reporting improved early natriuretic response ($P < 0.001$) and shorter length of stay versus usual care (5.8 versus 7.0 days; adjusted mean ratio 0.87; $P = 0.036$) [41].

Mechanistically, chloride delivery to the macula densa regulates renin release, and chloride depletion promotes distal sodium avidity via the With-No-Lysine kinase signalling pathway (WNK), with upregulation of the sodium–potassium–chloride cotransporter (NKCC, the loop diuretic target in the thick ascending limb) and the sodium–chloride cotransporter (NCC, in the distal convoluted tubule). Consequently, a low early post-diuretic urinary chloride can signal a chloride-depleted, diuretic-resistant state even after loop diuretic administration [42]. Early post-diuretic urine chloride < 72 mmol/L may offer a bedside signal for poor diuretic response (OR 39.0, 95% CI 3.8–405.0), slightly outperforming urine sodium thresholds in a 2025 prospective study, though further validation is needed [43].

Furthermore, risk stratification can be refined using the externally validated BAN-ADHF score (see Supplementary Table S3), which predicts low diuretic efficiency and adverse outcomes (internal AUROC 0.87; external AUROC 0.92; all DeLong $P < 0.001$) [44–46]. However, its use should currently support rather than dictate intensified therapy and monitoring decisions, as implementation evidence remains preliminary [44, 46].

Fluid restriction

When persistent hyponatraemia or diuretic resistance occurs, fluid restriction is pragmatically recommended by ESC guidelines, though biochemical gains are typically modest and outcome benefits uncertain in advanced HF [12, 47]. Moreover, a recent Heart Failure Association of the ESC clinical consensus statement advises against routine strict fluid restriction for most patients, instead supporting an individualised, less rigid approach guided by congestion, thirst burden, and patient tolerability [48]. Indeed, a recent multicentre outpatient randomised clinical trial, Fluid Restriction in Heart Failure versus Liberal Fluid Uptake (FRESH-UP; NCT04551729; n = 504), compared liberal intake with restriction to 1.5 L daily for 3 months. Quality

of life (QoL), measured by Kansas City Cardiomyopathy Questionnaire Overall Summary Score, showed no significant difference (adjusted mean difference 2.17, 95% CI − 0.06 to 4.39, $P = 0.06$). Restricted patients reported greater thirst with similar safety outcomes, challenging routine restriction in chronic HF [32]. Therefore, fluid restriction may be considered selectively, recognising limited efficacy.

Vasopressin V2 antagonism

Because V2-mediated water reabsorption in the collecting duct represents a final common pathway for dilutional hyponatraemia, selective V2 antagonism provides a direct, physiology-based pharmacotherapy [6, 8, 26]. Early short-term studies of intravenous conivaptan in advanced HF demonstrated dose-dependent increases in urine output and reductions in filling pressures without major hypotension [49]. In SALT-1 (NCT00072683) and SALT-2 (NCT00201994), oral tolvaptan (15 mg once daily, titrated to 30–60 mg) increased serum sodium versus placebo in euvolaemic and hypervolaemic hyponatraemia, including a substantial HF subgroup [50].

EVEREST (NCT00071331) primarily evaluated hospitalised HF rather than hyponatraemia per se, and only a minority of participants (approximately 11%) had baseline hyponatraemia [33]. Tolvaptan was found to be associated with improved short-term congestion markers and serum sodium but did not improve long-term mortality or HF rehospitalisation overall [33]. In a post hoc analysis focusing on patients with hyponatraemia, no long-term benefit was seen across the overall hyponatraemic cohort; however, patients with more pronounced hyponatraemia (serum Na < 130 mmol/L) showed a potential signal towards lower post-discharge cardiovascular morbidity and mortality [51]. As these findings arise from subgroup analyses however, they remain exploratory and support the need for a dedicated randomised trial enriched for severe hyponatraemia. Consistent with this, a 2024 meta-analysis of 17 randomised trials (n = 10,039) similarly support short-term correction of hyponatraemia and congestion surrogates, with neutral effects on hard outcomes [34].

The recent 2025 AVANTI trial (NCT03901729) provides additional context by testing pecavaptan, a dual V1a/V2 antagonist, in patients with acute HF and residual congestion. As adjunctive therapy, pecavaptan did not improve 30-day weight loss or serum creatinine versus placebo, while its post-discharge use in place of furosemide met non-inferiority criteria for weight change, with numerically higher congestion events reported [52]. Because AVANTI was not designed around hyponatraemia endpoints, we cite it here only to provide brief context on vasopressin antagonism and diuretic strategy, rather than as evidence to guide hyponatraemia-directed treatment.

Overall, we suggest considering tolvaptan for inpatients with persistent dilutional hyponatraemia despite an appropriate decongestion strategy, initiating 15 mg once daily and titrating to 30–60 mg with frequent serum sodium monitoring [6, 8, 26, 31, 33, 34, 36]. Earlier in-hospital initiation may shorten hospitalisation and improve discharge sodium in selected patients, although evidence remains observational [53]. Access and cost-constraints, however, remains to be relevant consideration causing to it being reserved for selected in-patients with severe symptomatic or refractory dilutional hyponatraemia in several health institutions as shown by cost evaluation studies in the United States and in Thailand [8, 54].

Oral urea

Oral urea augments electrolyte-free water clearance by increasing renal solute load and may be considered when dilutional hyponatraemia persists despite decongestion, fluid restriction is impractical, or vaptans are contraindicated (e.g., hepatic compromise) [55]. We suggest that oral urea be started at 0.25 to 0.5 g/kg/day, approximating to 15 to 30 g/day, in 1–2 divided doses, dissolved in water, with close serum sodium monitoring to avoid overly rapid correction [24, 35]. Treatment can typically be used as a short course and discontinued once serum sodium stabilises [24, 55]. Although current evidence quality is moderate and stronger for SIADH than HF specifically, a 2024 Spanish observational study (n = 96) found that adding urea to standard dilutional HF therapy corrected chronic hyponatraemia ($P < 0.009$ at 24 h; $P < 0.005$ at 120 h) over 5 days without major renal or haemodynamic adverse effects, supporting selective use [55].

Discharge planning

Before discharge, confirm clinical stability, improving or stable sodium within planned correction limits, and an optimised diuretic regimen tailored to achieved euvolaemia. Discontinue or replace precipitating agents such as thiazides whenever possible [12, 24]. In patients with prior rapid autocorrection or high osmotic demyelination risk, arrange closer outpatient monitoring with clear instructions to pause urea or defer diuretic escalation if sodium rises faster than intended [12, 24].

Treatment of severe hyponatraemia in heart failure

Patients with severe to moderately severe hyponatraemia symptoms, including seizures, coma, marked confusion, or active vomiting, require immediate hypertonic saline therapy regardless of aetiology (Fig. 1; Supplementary Figure S1) [6, 24, 31, 56]. Administer 150 mL of 3% saline over 20 min in a continuously monitored setting, necessitating intensive care unit admission. Reassess neurological status and serum sodium approximately 20 min after each bolus. Repeat up to two additional boluses if symptoms persist. Target a prompt rise of 4–6 mmol/L in the first hours to reverse cerebral oedema, then decelerate correction.

Correction limits and osmotic demyelination prevention

Briefly, ODS often follows a biphasic course. Patients may initially improve as hyponatraemic encephalopathy resolves, then deteriorate 2 to 6 days later with new neurological deficits after sodium correction. Clinicians should suspect ODS when dysarthria, dysphagia, spastic paraparesis or quadriparesis, pseudobulbar features, movement disorders, or reduced consciousness develops in this timeframe, and severe cases can progress to locked-in syndrome or coma; early magnetic resonance imaging can be normal, so clinical suspicion matters [12, 20, 57]. Apply strict guardrails to prevent ODS: limit correction to 10 mmol/L in the first 24 h and 8 mmol/L per 24 h thereafter [6, 24]. In patients at higher ODS risk, including those with alcohol misuse, malnutrition, advanced liver disease, or baseline sodium ≤ 105 mmol/L, restrict first-day rise to < 8 mmol/L [6, 24, 36]. Prefer bolus dosing in HF to limit fluid load, discontinue thiazides and other precipitating drugs, and resume guideline-directed decongestion once neurological stability and safety limits are achieved [4, 12, 14, 31, 36]. Monitor sodium at least every 2–4 h throughout the first day following the emergency phase [6, 24].

Overshoot prevention

Overcorrection prevention is integral to management. If sodium rises faster than target limits, immediately stop hypertonic infusions, administer free water, and use desmopressin to halt aquaresis [6, 36]. Many centres employ proactive desmopressin clamping, that is, scheduled desmopressin with titrated 3% saline to control correction rate [58, 59]. Recent observational data, retrospective studies, and systematic reviews suggest this strategy reduces overcorrection, particularly when brisk water diuresis is anticipated [37, 58, 59]. However, one small randomised trial found no significant advantage over reactive use [60], therefore, clinicians should individualise the approach based on autocorrection risk. Continue frequent sodium monitoring, track urine output, and correct hypokalaemia promptly, as potassium repletion independently raises serum sodium [24, 31, 36]. Once hyponatraemic encephalopathy resolves, address underlying HF physiology using guideline-directed management [12, 36].

Limitations, knowledge gaps, and research priorities

This mini review is a narrative synthesis rather than a systematic review, so it does not use a preregistered search strategy or formal risk-of-bias grading, and selective emphasis remains possible. Many studies prioritise short-term surrogates (e.g. serum sodium, urine electrolytes, weight, urine output) and several signals derive from post hoc or observational analyses. Trials of vasopressin antagonists largely enrol broader HF populations with only a minority of hyponatraemic participants, limiting outcome-level inference specific to hyponatraemic HF and leading us to suggest that a dedicated randomised outcomes trial in hyponatraemic HF remains overdue. Accordingly, the proposed framework and supplementary tables support phenotype-informed decision-making and monitoring rather than replace clinical judgement.

Important uncertainties persist despite clearer diagnostic pathways and pragmatic treatment algorithms. First, biochemical classification at the bedside remains imperfect in diuretic-exposed patients [10, 24, 36, 43]. Spot urine sodium thresholds are confounded by loop or thiazide-induced natriuresis, while fractional excretion of uric acid and urine chloride lack robust prospective validation in HF cohorts and are inconsistently applied [24]. Comparative studies with adjudicated outcomes should test composite diagnostic strategies integrating urine osmolality, urine sodium, urine chloride, fractional excretion of uric acid, and clinical phenotyping, with sampling protocols anchored to diuretic timing and dosing [26, 43].

Second, therapies that rapidly raise sodium levels, such as urea and vasopressin antagonists, have uncertain effects on patient-centred outcomes [26, 34, 36, 53]. Trials powered for clinical endpoints and enriched for hyponatraemic patients are therefore needed [34, 53]. While oral urea is biologically plausible and inexpensive, HF-specific evidence is limited to observational studies [55]. Randomised comparisons of urea versus vaptans, fluid restriction strategies, or intensified loop diuretic therapy, with safety, and QoL outcomes, remain research priorities [26, 55].

Finally, current safe-correction limits for serum sodium derive largely from observational data and expert consensus rather than prospective trials [24]. These limits aim to minimise osmotic demyelination risk, prompting some clinicians to use proactive desmopressin clamping to stabilise correction trajectories [60]. However, recent studies have yielded inconsistent findings regarding proactive versus reactive dosing strategies [58, 61]. Larger trials are therefore needed to elucidate desmopressin's optimal role in this context. Additionally, HF-specific protocols defining clamping eligibility criteria, dosing schedules, and stopping rules should be developed and rigorously tested. Moreover, HF-specific protocols that define eligibility for clamping, dosing schedules, and stopping rules should also be developed and rigorously tested [24, 60].

Conclusions

Hyponatraemia in heart failure is best understood as a physiological signal rather than an isolated therapeutic target. Optimal care requires early mechanistic recognition and correction that proceeds in parallel with safe decongestion. Paired serum and urine testing anchors diagnosis and stratifies therapy, distinguishing dilutional from depletional states. Hypertonic saline boluses remain reserved for neurological compromise, isotonic saline is appropriate when true hypovolaemia is present, and persistent dilutional hyponatraemia is addressed through diuretic-centred decongestion with selective, short-term use of emerging options such as tolvaptan or urea. Potassium repletion, careful monitoring, and avoidance of rapid autocorrection remain pivotal safeguards. Framed within this strategy, sodium normalisation is not an end in itself but may facilitate symptom control and discharge planning in selected patients, while supporting optimisation of guideline-directed therapy. Future work must refine diagnostic thresholds, validate algorithms, and identify which phenotypes derive outcome benefits from adjunctive therapies beyond biochemical correction.

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Declarations

Competing interests The authors declare no competing interests.

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